U.S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
Division of Forest Insect Research

FOREST INSECT CONDITIONS SEQUOIA NATIONAL FOREST AND SEQUOIA-KINGS CANYON NATIONAL PARK AUGUST 1957 APPRAISAL SURVEY

INTRODUCTION

Serious losses from bark beetles in timber stands surrounding the McGee Burn were found from surveys conducted in August. The area affected is located principally on the Hume Lake District, Sequoia National Forest and on adjacent lands within the Sequoia-Kings Canyon National Park. The fire contributing to this outbreak occurred in September 1955. It killed outright most of the trees on the 16,580 acres burned and injured the others on the burn perimeter. These damaged trees provided breeding grounds for bark beetles.

The timber around the McGee Burn has been under surveillance by the Station for signs of unusual insect activity since the fire. In the fall of 1956 a ground survey was made, but no evidence of a developing outbreak was detected. In the spring of 1957 aerial surveys disclosed that bark-beetle activity was on the rise, but this observation could not be ground checked immediately. Between July 23 and 27, 1957, three detection reports were received from cooperators, indicating a pronounced increase in bark-beetle damage. M.E. Thede, National Park Service, reported serious losses in Grant Grove. Knox Marshall, Western Pine Association, reported large groups of pines dying on Forest Service land near Grant Grove and the McGee Burn. D.F. Schlobohm, California Division of Forestry, reported an increase in beetle activity near Miramonte, within the burn.

Ground surveys were started by Station entomologists soon after these detection reports were received. On July 29, R.C. Hall reconnoitered the outbreak area, particularly Grant Grove. This examination confirmed preliminary reports concerning the serious nature of the outbreak, and it showed that an immediate appraisal survey was needed to develop quantitative information about the infestation. A plan for such a survey was developed by G.C. Trostle.1/ Subsequently, August 5 to 9, the appraisal was carried out under Trostle's direction. B.E. Wickman, J.R. Batchelder, and

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1/ Study plan for Appraisal Survey of McGee Fire Area, Kings Canyon National Park and Sequoia National Forest August 1, 1957

C.J. DeMars assisted in this work. Personnel from the State Division of Forestry, National Park Service and Sequoia National Forest helped facilitate the survey in many ways, particularly in familiarizing the survey crew with local conditions.

This report describes the procedures and also presents the results obtained in the appraisal. It also discusses possibilities for control and measures which could be applied to suppress the outbreak.

INFESTATION AREA

The bark-beetle-infestation area is restricted to the ponderosa pine and mixed conifer forest types centering around the McGee Burn. As shown by the attached map (fig. 1), the infestation area is triangular in shape. It is bounded on the north by the Kings River Canyon, on the east by non-host true fir, and on the southwest by the San Joaquin Valley.

At the lower elevations (2,000-4,000 feet) along the southwest edge of the infestation, the timber type is second-growth ponderosa pine. It is mostly privately owned and recently cut over, leaving trees that are small and widely spaced. At the higher elevations (5,000-7,000 feet), a virgin mixed-conifer stand of sugar pine, ponderosa pine, Sierra redwood, cedar, white and red fir and some Jeffrey pine occurs. The higher elevation area is formed by two intersecting ridges. One runs south from Converse Mountain through Cherry Gap along Park Ridge to Redwood Mountain. The other, not as high, runs southeast from Delilah Lookout along Pine Ridge, over Mt. Sampson and Stonage Point to Happy Gap, and from this saddle the ridge extends east to intersect with the higher one at Park Ridge Lookout. Much of this area is within the National Park. The land intermediate in elevation between these two zones (4,000-5,000 feet) is managed almost entirely by the Forest Service. The timber is of two types. The south and west slopes, south of Happy Gap on Highway 180 and west of the north-south ridge, support pure stands of ponderosa pine. To the north and east, this central area contains virgin stands of both pure ponderosa and the mixed types. The remainder is cut over or burned. Salvage cutting within the burn has been in progress during the last two years so that many of the large-diameter trees have been removed.

The trees in the infestation area varied greatly in size. In the cutover stands at the lower elevations and in much of the area in the burn perimeter, the trees were pole-sized. At elevations between 4,000 and 5,000 feet the stands consisted of old growth or large second growth. Trees up to 36 inches were not uncommon. At the higher elevations, above 5,000 feet, very little cutting has been done, although some second-growth stands occur in this area, i.e., those on YMCA land around Sequoia Lake. In the old-growth stands trees 40 to 80 inches in diameter are common.

The topography of the entire area is rough and steep, rising about 1,000 feet per mile, from 2,000 feet at the lower timber line, to 7,000 feet in the Park.

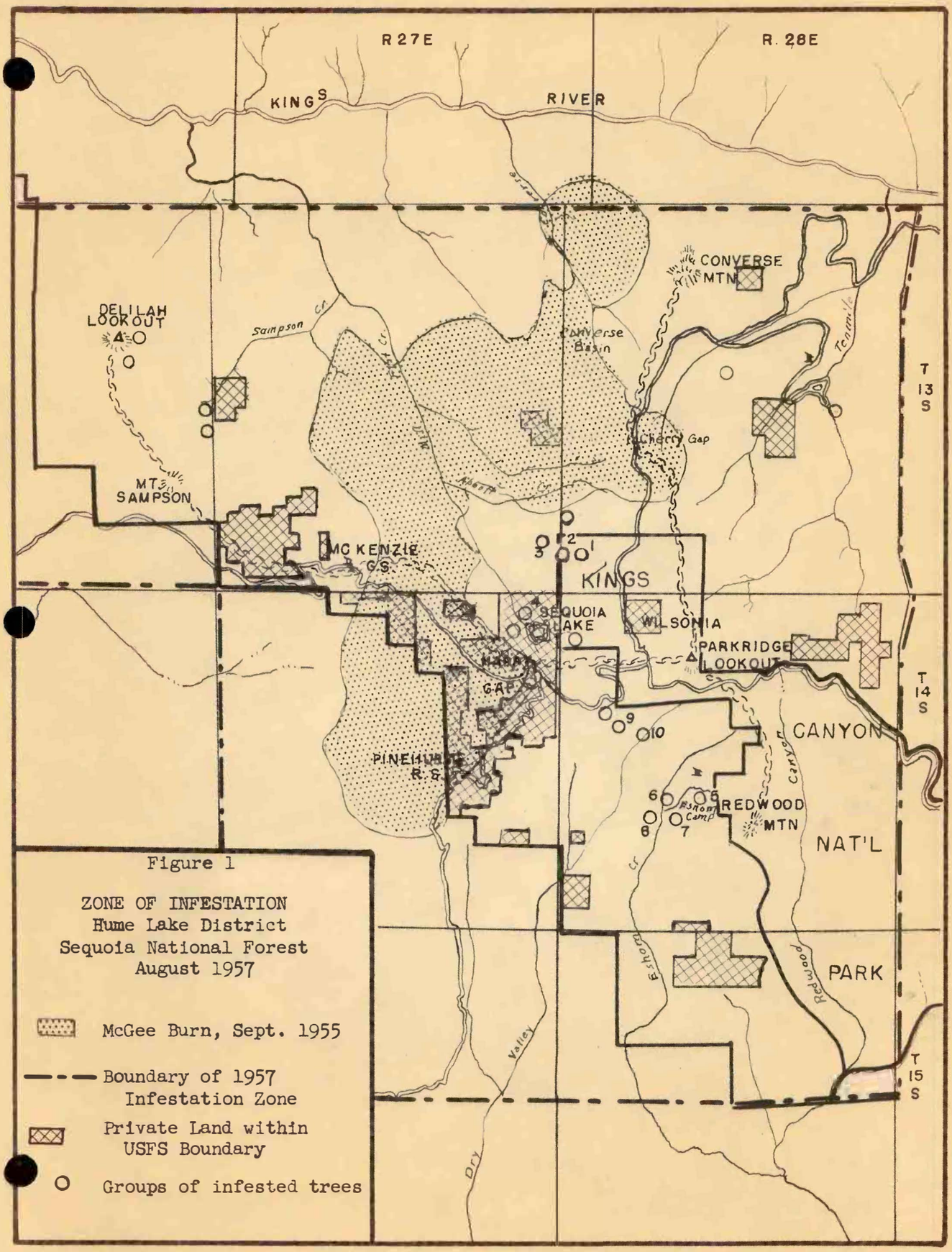

Figure 1

ZONE OF INFESTATION
Hume Lake District
Sequoia National Forest
August 1957

McGee Burn, Sept. 1955

Boundary of 1957 Infestation Zone

Private Land within USFS Boundary

Groups of infested trees

INSECT AND HOST SPECIES

The principal insects and host species involved in this outbreak are the western pine beetle (Dendroctonus brevicomis Lec.) on ponderosa pine, and the mountain pine beetle (D. monticolae Hopk.) in sugar pine. Three other species of bark beetles were found during the survey, but none were causing serious losses. The red turpentine beetle (D. valens Lec.) was very common in pines attacked by the western pine beetle and mountain pine beetle; but it was seldom seen in trees not attacked by these species. Also observed were the Jeffrey pine beetle (D. jeffreyi Hopk.) in Jeffrey pine and the fir engraver (Scolytus ventralis Lec.) in white fir. Losses from these insects were minor.

PROCEDURE

Aerial and ground methods were used to obtain information needed in appraising the infestation. The aerial survey was made by B.E. Wickman and G.C. Trostle on August 5. It consisted of a 2-hour reconnaissance of the area in a chartered Cessna 182. The purpose was to determine the area affected, locate and map groups of beetle-killed trees, and obtain estimates of their number.

The aerial survey disclosed that infested trees were distributed almost continuously around the burn, whereas outside the burn they were in scattered groups. Because of this difference in distribution, two different techniques were used on the ground survey, conducted August 6 to 9. Around the burn perimeter, strip samples 1-chain wide, and from 10- to 40-chains long, were taken. These were oriented in cardinal directions, and extended from the edge of the completely burned area, through the area covered only by ground fire, into the edge of the unburned timber. Four areas were sampled in this manner: McKenzie Ridge, Mill Flat Creek, Abbot Creek and Tuolumne Basin. The number of acres in strip samples totaled 121.

Outside the burn perimeter the procedure was to examine known groups of beetle-killed trees. These were groups that had been spotted in the aerial survey or located by local personnel. In the Park, for example, Park Service personnel had mapped most of the infested trees present. Ten of the groups were checked as follows: 3 in the northwest corner of Grant Grove, 1 on the shore of Sequoia Lake, and 6 in the Eshom Creek drainage. In both group and strip sampling, all freshly faded 1957 infested trees over 6 inches d.b.h. were recorded by 2-inch-diameter classes. Tree species, presence of fire damage, and the species of attacking insects were all noted. The amount of red turpentine beetle activity was estimated as light, medium, or heavy.

STATUS OF INFESTATION

The survey showed that the infestation was distributed over an area estimated at 73,000 acres (table 1). Within this area, more than 7,750 trees, having a salvageable volume of 6.1 million board-feet, were currently infested. About 5,200 of these trees (1.29 per acre) occurred on 4,000 acres of heavy infestation on National Forest lands within the burn. Although most of these trees were small, there were many of them, so that in aggregate they total about 2 million board-feet. About 300 of the infested trees were in the Park, 200 in the Grant Grove area, and an additional 100 on adjoining Park land. The total volume of these trees is estimated at 1 million board-feet. On 640 acres of YMCA land around Sequoia Lake, there were approximately 250 infested trees, with about 100,000 board-feet. On Sequoia National Park land outside the burn, but within the zone of heavy group killing, it is estimated that there were 2,000 trees with a total volume of 3 million board-feet.

The data obtained in the strip and group samples are summarized in tables 2 and 3. These data indicate that a severe bark-beetle outbreak developed in fire-injured timber in the burn, and that a serious infestation also occurred in the green, virgin and cutover stands nearby. The severity of the infestation is indicated by the fact that 20 to 30 tree group-kills, with trees up to 50 inches in diameter, were not uncommon. Also important is the fact that many thrifty young trees were attacked and killed.

Table 1.--Estimated number and volume of infested trees, and estimated acreage infested, by area

No.	Area	Number of acres	Est. no. infested trees	Ave. bd.-ft. vol./tree	Ave. bd.-ft. of salvageable volume
1.	Grant Grove	4,500	300	5,875	1,000,000
2.	USFS within burn	4,000	5,200	163	2,000,000
3.	Outside of burn USFS in area of heavy grouping	25,000	2,000	1,500	3,000,000
4.	YMCA	640	250	400	100,000
5.	Other private	12,360	-	-	-
6.	USFS area outside burn with scattered losses	26,500	-	-	-
	Total infested area	73,000	7,750	-	6,100,000

Table 2.--Number and volume of infested trees in groups sampled outside burn

No.	Area	Sugar pine: No. trees	Sugar pine: Ave. vol. per tree	Ponderosa pine: No. trees	Ponderosa pine: Ave. vol. per tree	Number all species over 20 in. d.b.h.	All species: Total	All species: Est. vol. per group
1.	Grant Grove Road Junction	3	5,520	11	8,700	14	14	112,260
2.	Grant Grove NW Cor.	4	3,300	2	2,560	6	6	18,320
3.	Lakeview YMCA	0	---	18	2,560	17	18	46,080
4.	Sequoia Lake YMCA	3	50	131	50	21	134	6,700
5.	Old Sawmill USFS	0	---	58	330	33	58	19,140
6.	Eshom Camp Ground USFS	3	210	11	480	10	14	5,910
7.	Eshom Meadows East USFS	0	---	17	230	8	17	3,910
8.	Eshom Meadows West USFS	0	---	32	150	8	32	4,800
9.	South of Big stump USFS	0	---	34	2,130	25	34	72,420
10.	Hart's Mill	0	---	4	2,560	4	4	10,240

Table 3.--Number and volume of infested trees per acre by species on sample strips in burn perimeter

Area	No. acres in sample	Sugar pine: No. trees	Sugar pine: Vol. bd.-ft.	Ponderosa pine: No. trees	Ponderosa pine: Vol. bd-ft	White fir: No. trees	White fir: Vol. bd-ft	All Species: No. trees	All Species: Vol. bd-ft
McKenzie Ridge	7	2.00	319	9.00	260	0	0	11.00	579
Abbott Creek	48	0.23	50	0.43	114	0	0	0.66	164
Converse Basin	40	0.65	564	0.05	6	0.20	60	0.90	630
Mill Flat Creek	26	0.62	593	0.31	208	0.11	27	1.04	828
All areas	121	0.55	354	0.78	107	0.09	26	1.42	487

Some variations were found in the bark-beetle broods in the infested trees. In sugar pine most all stages of mountain pine beetle were present, from eggs to callow adults. The majority of the broods were large larvae at the time of the survey. In ponderosa pine western pine beetle was found in the same stages. Although no new attacks were found, emergence holes were seen on many trees indicating that some new adults were present in the area. Broods of both the western pine beetle and mountain pine beetle were fairly heavy. There was a wide variation in the rate of brood development throughout the infested area. This was probably due to two factors: (1) differences in the rate of development of the two bark beetle species; and (2) elevational differences, particularly temperature, in different parts of the area.

Red turpentine beetle attacks were exceptionally abundant in pines attacked by western pine beetle and mountain pine beetle. Broods of red turpentine beetle were commonly found encircling the base of a fading tree and extending 8 to 10 feet up the bole. Normally, attacks are spaced about the base and seldom extend above 3 feet. No trees were found which had been killed by red turpentine beetles, but the aggressive nature of this infestation is so unusual that it is not known what its potentialities may be.

Previous studies have shown that bark beetle outbreaks often develop around burns within 2 years after fires occur in the ponderosa pine and mixed conifer types. The presence of large quantities of fire-injured trees is an important factor in the development of these outbreaks. In the present case, developments were not followed closely enough to prove the relationship between the fire and the subsequent insect outbreak. However, because the outbreak seems to have developed in the pattern that is usually associated with fires, and because of the proximity of the infestation within the McGee Burn to the one in the adjacent stands, it is logical to expect that the two are closely interrelated, if not interdependent.

Outbreaks of this type can be expected to decline from natural factors in due course. Part of the decline may be accounted for by the change in breeding material from fire-weakened to healthy trees, since the latter probably absorb some of the population. Part may also be accounted for by increases in the number of natural enemies. Because of the large size of the infested area, the large number of infested trees, and the comparatively heavy broods in this particular outbreak, it does not seem likely that natural factors alone will cause it to decline rapidly. The infestation is not expected to spread beyond the boundaries shown on the attached map (fig. 1) due to lack of host type. Within these boundaries, however, host material is abundant and infested trees are well scattered, so that considerable additional loss could take place if the epidemic continues. If this should happen, losses in 1958 may increase. And if no action is taken to control the outbreak, abnormal losses may continue for some time.

CONTROL POSSIBILITIES

Several possibilities exist for controlling the bark beetle outbreak in the vicinity of the McGee Burn. All involve the use of one or more methods of direct control on infested trees: (1) salvage logging, (2) fell-spray, using ethylene dibromide in diesel oil, and (3) fell-peel and burn.

Salvage of the accessible merchantable trees, and chemical treatment of the unmerchantable and inaccessible trees, is suggested. Salvage of much of the infested material should be feasible, for many of the trees are large, grouped together and near existing roads. Where the trees cannot be salvaged because of their inaccessibility or small size, chemical treatment or burning should be satisfactory. Burning probably would have only limited use within the fire-denuded area where small trees could be piled and ignited. Elsewhere, ethylene dibromide could be used in treating unsalvable trees. The formulation recommended is 1 pint of 8 percent EDB concentrate diluted with diesel oil to make 5 gallons. This material should be applied to the bark surface of felled trees as described by Downing.2/

Chemical control is likely to be very costly, particularly for large trees such as those in the Park. It is estimated that the average volume of spray required would be in excess of 50 gallons per tree, and that the cost of treating, including the chemical and labor, would be $50 to $100 per tree.

Any control program undertaken must be completed rapidly for maximum results. In order to destroy the most beetles before they have had an opportunity to emerge and attack new trees, control should be completed by the middle or latter part of September. A fall control program alone cannot be expected to solve the entire problem. Additional work may be necessary in the spring of 1958 to control beetles in trees that were not detected and treated previously.

Berkeley, California
November, 1957

C.G. Trostle
C.B. Eaton,
Entomologists

2/ Downing, G.L. Ethylene dibromide sprays for controlling bark beetles in California, CF&RES Misc. Paper No. 17, Oct. 15, 1954.